

-32-

**Claims:**

1. A column protector device for protection of an upright column of a racking system, said device comprising:

an outer shell; and

an inner liner shaped to fit within said outer shell;

wherein said outer shell is configured to fit around a said upright column, such that the outer shell retains to said column in a self attaching without he need for any additional fixings, and such that, in use, said inner liner is retained between said outer shell and said column.

2. The column protector device as claimed in claim 1, configured to attach to the front and lateral sides of an aisle facing rack upright.

3. The column protector device as claimed in claim 1, wherein said outer shell comprises an elongate member having a substantially "C" shaped cross section.

4. The column protector as claimed in any one of the preceding claims, wherein said outer shell comprises a substantially part cylindrical partial tube.

5. The column protector device as claimed in any one of the preceding claims, wherein said outer shell comprises a tubular part cylindrical member having a pair of substantially parallel opposing edges, either side of a gap in said part cylindrical member.

-33-

6. The column protector device as claimed in claim 11, wherein said part cylindrical member extends over an angle in the range  $260^{\circ}$  to  $280^{\circ}$ , about a longitudinal centre line of said outer shell.

7. The column protector device as claimed in any one of the preceding claims, wherein said outer shell has a height in the range 30cm to 120cm.

8. The column protector device as claimed in any one of the preceding claims, wherein said outer shell has an external diameter in the range 10cm to 14 cm.

9. The column protector device as claimed in any one of the preceding claims, wherein said outer shell has a wall thickness in the range 7mm to 9mm.

10. The column protector device as claimed in any one of the preceding claims, wherein said outer shell has a distance between opposing longitudinal edges in the range 5cm to 11cm.

11. The column protector device as claimed in any one of the preceding claims, wherein said outer shell comprises a chamfered edge positioned at an end of the shell, between an upper face of the outer shell and an inner surface of the shell.

12. The column protector device as claimed in any one of the preceding claims, wherein said outer shell is made from a resilient elastomeric polymer based material.

13. The column protector device as claimed in any one of claims 1 to 11, wherein said outer shell comprises at least one material selected from the

-34-

set: Polyethylene; Polypropylene; Polycarbonate; Polyvinylchloride; Polystyrene plastic; or a mixture of plastics.

14. The column protector device as claimed in any one of claims 1 to 11, wherein said outer shell is made from a high density polyethylene material.

15. The column protector device as claimed in any one of the preceding claims, wherein said inner liner comprises a part – cylindrical member.

16. The column protector device as claimed in any one of the preceding claims, wherein said inner liner comprises a substantially solid part cylindrical member having a substantially part cylindrical outer surface, and a substantially “U” shaped channel formed on an opposite side of said liner to said substantially cylindrical outer surface.

17. The column protector device as claimed in any one of the preceding claims, wherein said inner liner comprises an elastomeric material which is relatively less dense than a material of said outer shell.

18. The column protector device as claimed in any one of claims 1 to 16, wherein said inner liner comprises a material selected from the set: Polyethylene; Polypropylene; Polycarbonate; Polyvinylchloride; Polystyrene; natural rubber foam; synthetic rubber foam; a compressive composite material.

19. The column protector device as claimed in any one of the preceding claims, in which said inner liner comprises a closed cell SBR foam material.

20. The column protector device as claimed in any one of the preceding claims, wherein said inner liner has a height in the range 30cm to 120cm.

-35-

21. The column protector device as claimed in any one of the preceding claims, wherein said inner liner has an external diameter in the range 10cm to 14 cm.

22. The column protector as claimed in any one of the preceding claims, wherein said inner liner has a "U" shaped channel of width in the range 7cm to 12cm.

23. The column protector as claimed in any one of the preceding claims, wherein said inner liner has a "U" shaped channel of depth in the range 2cm to 4cm.

24. The column protector device as claimed in any one of the preceding claims, wherein said inner liner has a "U" shaped channel, and wherein a maximum distance of an outer surface of the "U" shaped channel to the outer part cylindrical surface is in the range 2cm to 5cm.

25. The column protector device as claimed in any one of the preceding claims, wherein said inner liner is configured such that, after receiving an impact, the inner liner promotes the repositioning of the whole device to a position similar to a position of the device before an impact occurred.

26. The column protector device as claimed in any one of the preceding claims, in which said outer shell, when fitted to an upright column, having a front member and first and second side members, surrounds the front member, and partially surrounds first and second side members thereby protecting the front member and parts of the side members from direct impact and partially surrounds each of the first and second side members, said outer shell also surrounding said inner liner, which resides, in use between a substantially part cylindrical inner surface of the outer shell, and an outer face of the front member, an outer face of the first side member and an outer face of the second side member .

-36-

27. The column protector device as claimed in any one of the preceding claims in which said inner liner and said outer shell are slideable with respect to each other in a direction along a main central axis of said outer shell.

28. The column protector device as claimed in any one of claims 1 to 27, in which said inner liner is bonded to an inner surface of the outer shell, such that the inner liner is fixed relative to the outer shell and cannot slide relative to the outer shell.

29. The column protector device as claimed in any one of the preceding claims, further comprising a polycarbonate outer sheath which fits outside the outer shell and which is selected such that it shall only fail to crack propagation from forces that would exceed the device's maximum designed impact tolerance.

30. The column protector device as claimed in any one of the preceding claims, further comprising a polycarbonate insert member which is capable of being inserted between the device and the front face of the column upright and which is capable of being slid out from such position for removal and capable of being re-inserted, for visual inspection purposes without the need to remove the outer shell or inner liner from the column upright.

31. A column protector device for protection of an upright column of a racking system, said device comprising:

a substantially part cylindrical tubular outer shell; and

an inner liner shaped to fit within said outer shell.

32. An upright column protector device comprising:

-37-

an assembly of elastomeric synthetic compound components that partially encapsulate the principal elements of the vertical sections of a metal pallet rack for the purpose of preventing impact damage caused to the pallet rack by mechanical handling equipment.

33. A device as claimed in claim 32, wherein the assembly of multilateral, semi tubular, components has greater ductility, impact resilience and persistence of shape than that of the metal rack component it is attached to.

34. A device as claimed in claim 33, wherein the assembly of components does not essentially concomitant an integrated or independent fastening or securing mechanism or mechanisms or bonding agent with which to be fixed to a pallet rack.

35. A device as claimed in claim 34, wherein there is an external component that is semi tubular in shape and is manufactured from, , Polyethylene, Polypropylene, Polycarbonate, Polyvinylchloride or Polystyrene plastic; or a mixture of plastics.

36. A device as claimed in claim 34, wherein there is an internal component that is synergistic in form and function to that of the external component and is manufactured from, Polyethylene, Polypropylene, Polycarbonate, Polyvinylchloride or Polystyrene, natural or synthetic rubber foams or compressive composite materials.

37 A device as claimed in any one of the preceding claims wherein wherein a said outer shell has an elastic modulus in the range 400 to 100 N/mm<sup>2</sup>.

38. A device as claimed in any one of the preceding claims wherein wherein a said outer shell has a Poisson ratio in the range 0.3325 to 0.3675.

-38-

39. A device as claimed in any one of the preceding claims wherein wherein a said outer shell has a tensile strength in the range 23.65 to 36.855 MPa.

40. A device as claimed in any one of the preceding claims wherein wherein a said outer shell has a density in the range 0.902 to 1.008 g/cc.

41. A device as claimed in any one of the preceding claims wherein wherein a said outer shell has a melt index at 109°C /21.6 kg of 0.076 to 0.084 g/cc.

42. A device as claimed in any one of the preceding claims wherein wherein a said outer shell has an ultimate elongation in the range up to 800% of original length.

43. A device as claimed in any one of the preceding claims wherein wherein a said outer shell has a flexural modulus in the range 982 to 1085 Mpa.

44. A device as claimed in any one of the preceding claims wherein wherein a said outer shell has a brittleness temperature of below – 111°C.

45. A device as claimed in any one of the preceding claims wherein wherein a said outer shell has a Shore hardness in the range 60.8 to 67.2.

46. A device as claimed in any one of the preceding claims wherein wherein a said outer shell has an impact strength in the range 0.4 to 0.441 KJ/m.

47. A device as claimed in any one of the preceding claims wherein wherein a said outer shell has a Vicat softening temperature in the range 117.8 to 130.2°C.

-39-

48. A device as claimed in any one of the preceding claims wherein wherein a said outer shell has a volume resistivity in the range greater than 964 ohm-cm.

49. A device as claimed in any one of the preceding claims wherein wherein a said outer shell has a thermal expansion coefficient in the range  $1.9 \times 10^{-4}$  to  $2.1 \times 10^{-4}$  cm/cm/°C.

50. A device as claimed in any one of the preceding claims wherein wherein a said inner liner has a Poissons ratio in the range 0.38 to 0.42.

51. A device as claimed in any one of the preceding claims wherein wherein a said inner liner has a flexural modulus in the range 0.665 to 0.735 Mpa.

52. A device as claimed in any one of the preceding claims wherein wherein a said inner liner has a tensile strength in the range 237.5 to 262.5 kPa.

53. A device as claimed in any one of the preceding claims wherein wherein a said inner liner has a density in the range 27.55 to 30.45 kg/m<sup>3</sup>.

54. A device as claimed in any one of the preceding claims wherein wherein a said inner liner has a tear strength in the range 480 to 530 N/m.

55. A device as claimed in any one of the preceding claims wherein wherein a said inner liner has an elongation at break in the range 90.25% to 99.75%.

56. A device as claimed in any one of the preceding claims wherein wherein a said inner liner has a Shore hardness 00 scale in the range 40.85 to 45.15.

-40-

57. A device as claimed in any one of the preceding claims wherein wherein a said inner liner has a compression strain characteristic of:

25% compression	33.25 to 36.75	kPa
40% compression	61.75 to 68.25	kPa
50% compression	95 to 105	kPa
60% compression	142.5 to 157.5	kPa

58. A device as claimed in any one of the preceding claims wherein wherein a said inner liner has a compression set, 72 hrs 50% compression 23°C, 1/2 hr recovery in the range 30.4% to 33.6%.

59. A device as claimed in any one of the preceding claims wherein wherein a said inner liner has a compression set, 48hrs 20% compression 23°C, 1/2 hr recovery 7.6% to 8.4%.

60. A device as claimed in any one of the preceding claims wherein wherein a said inner liner has a colour which is visually uniform within a foam structure.